Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

# THE SERVICE OF STATISTICS TO ECONOMICS.*

BY DAVID KINLEY, PHD., LL.D., *Director of the Courses in Business Organization, University of Illinois.*

On an occasion like this the temptation is great to use the opportunity and privilege of speaking, in extending congratulations to the organization in whose honor this company is gathered, on the long and distinguished service it has rendered to the science for the promotion of which it was founded. Though adding my word of testimony, I must leave to others the more extended presentation of the appreciation of the scientific world of the great service of the American Statistical Association.

A second temptation, to which one is subject on an occasion like this, is to use the few minutes at his disposal in reviewing the work that has been done in the particular field of which he speaks. If I were to do that I would be able, indeed, to paint an encouraging picture of progress in the application of statistics to economic science, and to pay a high tribute to the long list of names distinguished in this particular field of study. This opportunity, however, like the first, I must eschew. It is impossible in twenty minutes to present even a general survey of the history and application of statistics to economics with any hope that it would be intelligently followed even by an audience as appreciative and intellectually keen as a Boston audience is reputed to be.

Nor can I pause, much as I might like to do so, to discuss the nature and limitation of the statistical method in economics, or any phase of its technique. All these things, I must take it for granted, are so well known to you that their discussion would be unnecessary even had I the time to enter upon it. For these reasons I have chosen to confine my remarks in the main to a consideration of the nature of the economic problems which I think can be successfully dealt with by statistical methods, and to point out certain lines of investigation into which I think the statistical method can be pushed in the future with more success than hitherto.

---

* Paper presented at the seventy-fifth anniversary meeting of the American Statistical Association, Boston, Mass., February 14, 1914.

Statistics began as a social science, or, if you please, the statistical method found its first application in the study of social data. For a long time but little was done or could be done beyond the mere presentation in statistical form of some simple and easily gotten facts of economic life. Consequently, the high hopes with which many students welcomed the introduction of statistics into economic study became dim as the years passed by, and gradually there grew up a feeling that, after all, but little was to be hoped in the way of contributions to economic theory, at any rate, by the statistical method. Of late years the flame of hope has been kindled again, and there is some reason to think that the theoretical discussions carried on a generation ago on philosophical premises may find a new foundation and emerge in more accurate form on the basis of the statistical discussions now going on.

The principal service which, in the past, statistics have rendered and which, therefore, many people have come to think is its only possible service, to economics, is to afford an accurate form of summary statement of economic facts and changes. In other words, statistics enable us to present pictures of existing conditions showing wherein they are defective, according to some accepted standard, and so enable us to make suggestions of remedies for the defects. From this point of view they are simply a statement of facts of interest and importance presented in such a way as to enable the eye and mind to grasp them as a whole more readily and clearly. Their utility, therefore, lies in their adaptability to presentation in a succinct form. If we could present the same facts in the shape of a mathematical formula even a greater advantage would accrue.

In this view the statistical form of presentation is not considered as making any suggestion of relationships in the group or of possible remedies for defects. While I am one of those who think that this is not the whole service of statistics but only the first of a series of great services, and believe that we shall yet found many if not all of our economic theories on statistical data, yet it is true that until now the main result of the gathering of economic statistics has been to enable us to state more clearly the nature of the phenomena which we were studying.

This service of statistics can be readily illustrated by the records of unemployment which have been so generously gathered in the past ten or twenty years. The tabulation of employment or unemployment by trades, for example, reveals the character and extent of disturbances due to seasonal causes, to fashion and other irregular causes, to the character of the industry, and, therefore, throws light upon the obstacles which it is necessary for us to remove in order to reduce unemployment and make employment more continuous. The statistics themselves furnish no suggestion as to the methods of accomplishing this purpose. They simply indicate where and how the remedy, if one can be found, is to be employed. The remedy must be sought in our notions or standards of welfare outside of the statistics themselves. We cannot be sure that the facts presented in the statistical tables, showing for example seasonal unemployment, disclose a causal relation between seasons and unemployment. This conclusion must be reached on other grounds. To put the matter in another way, if our statistics show that at certain recurrent seasons of the year there is a certain amount of unemployment in certain industries, we must inquire into the nature of the industries before we can conclude that the unemployment is due to seasonal causes. To be sure, if we have a considerable series of such statistics on the same industries, and if the same facts are evident at recurrent periods, there is established a strong probability of a causal relation; but a single table of this kind at a given time cannot show this for us, although it may be of great value in enabling us to apply remedies to evil conditions existent at the time. Such remedies must, of course, under these circumstances, be purely empirical and tentative. In the case of the figures of unemployment in a series of tables showing the distribution of labor in the same industries in corresponding seasons, it may be that they will teach us the necessity and perhaps the way of distributing labor and readjusting industries. At any rate they will indicate what to prepare for in particular seasons in the way of extending help to those out of work. In short, the statistics indicate special problems which need attention and solution, or conditions needing specific treatment at the time.

The second service of statistics is to develop relationships of facts within particular groups of data, and lay bases for empirical laws. This service can be rendered to economics by statistics only if the statistics are so numerous that we can be reasonably sure that the facts which they present are representative of the group with which they deal, and so reflect the character of the group as a whole. Moreover, not only must they be thus representative on a particular occasion, but they must be so through a series of occasions. One of the readiest illustrations of what I have in mind is found in the well-known empirical formula sometimes known as Engel's law of expenditure among Prussian families. After investigating a great many budgets of expenditure of Prussian working-men's families, Engel came to the conclusion that certain definite proportions of expenditure of the total income ran through these budgets in a general way. For example, he found that a certain proportion of the total income of the average family went for rent; another somewhat definite proportion for food and shelter, and so on. Now, of course, no one has ever claimed that these proportions were fixed, or that they would be the same in another country, in another social class, or in the same social class at another time. The so-called law, in other words, is a purely empirical formula. It states in ordinary language relationships found to exist in a group of statistical data of a certain character, concerning a certain class, at a certain time, and under certain conditions. The conclusions were of great value, however, not only for purposes of economic description and history, but for showing the condition of the classes with whom they dealt, and revealing the points at which experiments must be made for possible improvement. It is possible to lay down a good many such empirical or positivistic laws for definite economic groups from the statistics already in our possession. Agricultural returns showing relatively decreasing yields for added capital and labor give us the empirical formula sometimes known as the law of agricultural diminishing returns. This particular formula has never been put in so definite arithmetical shape as Engel's law has sometimes been put, yet I can see that it would be possible on a limited area and under certain conditions of tillage to lay down an approximate arithmetically correct statement of the law under these conditions. Gregory King's famous attempt to establish an arithmetical relation between the changes in the price of wheat and changes in the annual crop is another illustration in kind. Formulas of relationship or empirical laws of this kind could be reasonably drawn only from statistics dealing with small statistical areas.

In the next place, economic statistics enable us to determine the direction or continuity of movement of the group with which they deal. When Agassiz long ago said that, in the biological sciences, "It is the comparative that is significant," he made a statement of equal importance for the statistics of economics. The statistical data must be comparable at different dates, so that a line of continuous movement, if it exists, may be traced through them if they are to serve any purpose other than that of satisfying curiosity, or, if you prefer, intelligent interest.

This service is closely connected with the second service, which I have just described, or that of enabling us to lay down what may be called positivistic or empirical laws of economics. Proper tables of statistics, wages, prices, expenditures, exports and imports, etc., show changes in welfare, indicating progress or retrogression. The important thing in such a series of statistical tables is the continuity of relationships within the group. They show economic movement. In so doing statistics have entered the field of dynamic economics. Such tables at the same time reveal movement and also suggest the nature of the movement and possible explanations of it. In other words we may find in the statistical tables themselves suggestions of the causal relationship of the phenomena presented, so that this service differs materially from that rendered by the kind of tables mentioned in the first instance. For example, tables of wages and prices collected at successive periods enable us not only to compare the condition of the working classes and the prosperity of industries, but may suggest causes or explanations of the changes which the tables reflect. In doing the first they form a basis for economic history. Rogers's History of Agricultural Prices, based on statistical data, and the work of Tooke and Newmarch in their History of Prices illustrate this service. Rogers's work presents figures showing the course of the wages of agricultural labor in England through a long period. The figures indicate not only changes in the condition of the agricultural laborer, but suggest probable explanations of these changes at different times. For example, when we find in such tables marked changes in the money income of agricultural laborers side by side with corresponding changes in other sources of income through the loss, for instance, of access to common pasturage, turbage, and similar rights, it is not difficult to see a causal connection in the figures themselves, aside from knowledge derived from other sources of political and social changes. To be sure, in a case like this, whatever conclusions we draw can never be entirely safe without being checked by knowledge from outside sources; but the point I am urging is that in the absence of such knowledge the figures themselves serve a good purpose in throwing some light on the changes that are going on.

Still again, economic statistics furnish a basis for legislation and administration. This is a service on which I need not enlarge. Governments the world over are recognizing its importance. The appointment of our own tariff commission is a recognition of this service. The industry with which governments collect and collate tax returns, the insistence of our interstate commerce commission upon proper statistical returns from railroads, and a large number of other illustrations will occur to every one. It is worth while mentioning specifically the latest proposal in this direction, namely, to gather statistics of industry of such character and in such form as to determine what constitutes a unit of maximum efficiency in an industry of a particular kind.

In an inquiry of this kind it would be necessary first to settle from what point of view efficiency is to be defined. Probably it would be efficiency in the sense of determining what is the largest amount of capital that could be employed in a given industry without endangering public welfare by putting industrial control in the hands of the owners of the capital, and at the same time promote public welfare by turning out product at lower costs than could be obtained with less capital, and still more to establish working conditions which would be better than those that could be established in an organization with a less capital. Personally, I believe the inquiry is a practicable one. Certain constants would have to be assumed and then the problem, statistically and mathematically, would amount to a collection of data to be used in the solution of a problem of maxima and minima.

Another service of statistics to economics is found in the possibility of tracing the effects of economic legislation. Beyond question this is difficult to do because of the multiplicity of influences in any economic operation. Moreover, pretty nearly every law produces results entirely unexpected by its framers and not infrequently of a character opposite to that which is aimed at. Nevertheless, in a general way, and sometimes in particular ways, it is possible through statistical data to trace the effects of particular laws. Inferences based upon such evidence appeal far more strongly to the public mind than do conclusions of the same character based on a priori consideration. The public brushes aside with impatience the opinions of critics of the modern system of workmen's compensation, accident and benefit insurance, and similar legislation, on the ground that these criticisms are *a priori*, theoretical, not based on facts, but on the critics' guesses about human need. When, however, a German authority publishes figures showing that the period of recuperation from accidents and illness under the influence of such legislation has been increased far beyond the normal period required for such recovery, the public is compelled to give attention to the situation.

All sorts of statements have been made about the effects of the reduction of our own tariff in recent months. While it is not true that one man's statement about such matters is as good as that of another, it is true that, if by the collection and proper presentation of statistics after a time we can show in actual figures what some of the results are, attention at least will be arrested. It should be possible to show the extent to which the industries thus less protected are disturbed, whether they have been obliged to curtail their activity, to dismiss some of their workmen, or have met the new situation by greater efficiency, reduced costs, or smaller profits. It should be possible, and certainly interesting, to trace the effect of this legislation on wages, prices and the cost of living; and to show, by figures of industrial establishments, whether the law has caused any new distribution of industry. Certainly tables of exports and imports ought to throw some light on this last question; for if it be true, as alleged, that we are importing more of the goods which have been in a measure deprived of their former protection, we must pay for them by exporting more goods of some other kind, and it ought to be possible to find statistics which will show whether industries of other kinds have expanded, or whether new industries have been established to furnish the products necessary to meet these larger foreign importations.

But little has been done in the application of statistics to the discovery of economic theory although much has been done in the use of statistics in the way of elucidation. The field, however, is one of great importance, concerning the feasibility of which there still is and always has been a good deal of skepticism. Is it possible to discover a law of interest, a law of wages, or any other general law from the statistics of the subject? By general theory I mean a general expression of the determining forces of a group of economic phenomena, such as wages, or interest, or prices, or the whole field of distribution. Of course, general theory cannot represent accurately "the life and movement of the economic world." It serves to show the general lines of probable truth. In the language of mathematics, a general theory derived from statistical data must be based on averages, and, therefore, must represent a type or limited case. It is the limit towards which actual cases tend indefinitely to approach. This must be so because such a theory must be a law of economic statics. It is conceivable, indeed, that even a dynamic law may be in time discovered from statistical data, but we are yet far from that possibility. However, the pure theory of economic statics has reached the stage where, as Prof. H. L. Moore shows, it can be put in mathematical or symbolic form as a type of the things which that explains.

A use of statistics for the purpose of developing a general theory is possible only by the use of proper mathematical methods. The data must be handled according to mathematical laws. Fortunately, as economic statistics have been developed the mathematical instrument or method for handling groups or masses of data has also been perfected. The calculus of phenomena in masses has been much developed, especially in the biological sciences in the past ten or fifteen years, and the tool of which Pearson and his colleagues have made such powerful and successful use lies ready to the hand of the student of economic facts.

Since the phenomena are numerous and mutually dependent they can be represented statistically and mathematically only if the statistics are reducible to a series of simultaneous equations, as numerous as the unknown quantities under consideration. It is a mistake to suppose that a series of figures on any one of the subjects of general theory can be treated as a simple equation, or represented graphically as a linear movement. For in dealing with general theory we must use what I have described as the complex homogeneous unit. The data in such a unit are more or less numerous and conflicting. If, however, we are reasonably sure that the character and degree of conflict is approximately constant through a series of successive units, so that, so to speak, the antagonistic elements neutralize one another, so far as concerns the main purpose of our inquiry such units can be used as successfully and logically as if they were homogeneous, in the simple sense of being uniform in character or makeup. One of the most successful illustrations of the use of statistics for the establishment of a general theory is Prof. H. L. Moore's admirable statistical treatment of the law of wages, which established statistically the specific productivity theory, and incidentally checked the deductive processes whereby that theory was reached in the first place.

One hestitates to use an illustration from his own work, yet with apologies for doing so I may be permitted to illustrate what I mean by a complex homogenous unit and the possible deduction of the general theory from statistical data, by a reference to what I laid down some years ago as the main features of what some of my colleagues have been kind enough to call a theory of credit. I used for my purpose the statistics which I obtained in connection with the investigation into the use of credit instruments in business payments, first in 1895 and later in 1903. It is commonly stated that there is no necessary connection between increasing population and volume of business, or, therefore, volume of payments or use of credit facilities. For a very different amount of business may be done on the basis of the same amount of money and by very different numbers of people. Yet if we can get a complex homogeneous unit, or one in which the other conflicting elements are numerous enough to justify us in supposing that they neutralize one another in the main, while the unit as a whole acts uniformly, I think we may make bold to try to establish some relation between population growth and the amount of money needed and the amount of credit built upon it, and by inference what I have called the static distribution of the precious metals. Not to go into details I calculated the percentage of credit payments for population groups at intervals, and plotted the irregular line which represented it. Smoothing out this line and making it into a better curve by one of the well-known devices, I finally secured what I regarded as a limiting curve from the character of which I made certain inferences as follows:

First, that the proportion of credit increases gradually with population in a country like ours, and under our conditions.

Second, that it increases with more or less regular periodical fluctuations, giving us a series of maxima and minima.

Third, that its rate of increase tends to become less rapid as the volume of population and, therefore, the volume of business grows.

These conclusions I rather jumped at by what may be called a bold imagination from the indications which the curve showed rather than proved by exact induction. When they were suggested to my mind I tried to see whether they could be established deductively, and succeeded, I think, in establishing them by this logical process. Indeed, so much more sure did I feel of the logical argument on account of the paucity of my data, that when I presented the subject some years ago I ignored the statistical presentation altogether, simply because it was so novel at that time and involved so many of what critics would be likely to call guesses, that I felt that the other presentation would appeal to my colleagues more successfully. It is my belief that similar use of carefully collected statistics will yet give us the ground on which we shall be able to formulate some of the general economic theories for which we are groping, and afford formulas wherewith to solve many problems of our industrial life.